SANYO TECHNICAL DATA LIQUID CRYSTAL DOI MATRIX DISPLAY MODULE LCM-567-31 ** (16×1 Line)

A : Reflective

HA: Transflective(posi)

N A: Ttransparent (nega)

* Super Twist 35 Nematic

Jun. 3 , 1987

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Liquid Crystal Dot Matrix Module

SANYO Dot Matrix Module LCM-567-31**(16 Characters × 1 Line) consists of STN LC display, C-MOS driver.C-MOS LSI to control and EL for back light. The module utilize 5×7 dot matrix characters to provide full alphanumeric capability. All control, refresh and display functions are executed by a dedicated on-board controller.

The module is capable of displaying the full 160-character JIS font set. Data interfacing is via an 8-bit bi-directional data bus or a 4-bit one. By use of simple control commands, data can be selectively written to (or read from) any cursor location, arbitrary fonts can be written to CHARACTER GENERATOR RAM.

1. FEATURES

- 1) Control LSI built in.
- 2) 5 × 7 dot matrix with cursor.
- 3) Microprocessor compatible data bus interface (8-bit or 4-bit).
- 4) Character generator ROM built in.
 - 5 × 7 font : Alphanumeric ---- 96 characters

 Japanese ----- 64 characters
- 5) Character generator RAM ----- Customer rewritable 5 × 7 font : 8 characters
- 6) Powerful control commands
 - ① Display clear
 - 2 Return home
 - 3 Cursor preset
 - ④ Cursor ON/OFF or Character blinking
 - 5 Cursor shift
 - 6 Display shift
 - ⑦ Display ON/OFF
 - B Display data read/write
- 7) ±5 volts power supply. (without EL power supply)
- 8) Low power consumption.
- 9) Light weight and extremely compact size
- 10) EL Back Light Option
 - A : Reflective Type without EL(Posi)
 - HA: Transflective Type with EL(Posi) EL Color:blue green
 - NA : Transparent Type with EL(Nega) EL Color:blue green

2. ABSOLUTE MAXIMUM RATINGS

 $V_{SS}=0V$, Ta=25°C

Item	Symbol	Min.	Max.	Unit	
Logic circuit Power supply voltage	V _{DD} - V _{SS}	0	7. 0	V	
LC driver circuit supply voltage	$v_{DD} - v_{o}$	0	13. 5	V	
Input voltage	٧L	VSS	V _{DD}	V	
Operating temp.	T _{OP}	0	50	°C.	
Storage temp.	$\mathtt{T}_{\mathtt{STG}}$	-20(100hr)	70(100hr)	°C	

3. ELECTRICAL CHARACTERISTICS

881 1 all Well 88VDD=5.0±0.25V; Ta=25°C

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input "High" Voltage	v _{IH}	and the second s	2. 2	-	V _{DD}	V
Input "Low" Voltage	VIL		_		0.6	V
Output "High" Voltage	V _{OH}	−I _{OH} =0. 205mA	2. 4	_	-	V
Output "Low" Voltage	V _{OL}	I _{OL} =1.2mA	_	-	0.4	V
Power Supply Current	I _{DD}	V _{DD} =5. 0V	_	ī. ō	2. 0	mA
Power Supply Voltage for LCD	was and the second of the second	Top=·0°C	8. 6	8. 7	8.8	V
(Recommended) (1/16 duty)	V _{DD} – V _o	Top=25°C	8. 1	8. 2	8.3	v
		Top=50°C	7. 3	7.4	7.5	V

4. TIMING CHARACTERISTICS

4-1. Write Operation

į.

V

						182 183					
		I	tem	Sym	nbol	Test Condition		Min.	Тур.	Max.	Unit
	Enabl	e cycle	e time	tey	c E	Fig. 1		1.0	_	_	μs
	Enabl	e pulse	e width	Ph	/EH	Fig	g. 1	450		_	ns
	Enabl	e rise	& fall time	tEr,	t EE	Fig	g. 1		_	25	ns
	Addre	ss set-	up time	t	AS	Fig	;. 1	140	_	_	ns
	Addre	ss hold	l time	t	АН	Fig	. 1 . 1 g	10	-	_	ns
	Data	set-up	time	t D	SW	Fig		195	-	_	ns
	Data	hold ti	merotatbao) d	eol t	H	eia Symb	1	10-11	1-		ns
1	****	2.2			Н	IA	9263.07	1.37 b			
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	Special position of the Control of t	2.4	w 2000 - W	.)		$i()^{\dot{V}}$	Voitside	·aath			
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	8	3.8	0.0 602				036510				
	R/U	3.11	VI		Version 1				VIL		
)	3	0.03=60			PVEI		tAII	t _E [_	
DI	B 0 ~ D B 7			V IL	V	111	VIII-	t	V III	v	ı L
					- &		t cyc E			3,	

Fig. 1 Writing Data (from MPU to Module)

4-2. Read Operation

Symbol	Test Condition	Min.	Тур.	Max.	Unit
tcyc E	Fig. 2	1.0	-	_	με
PWEH	Fig. 2	450	_	-	ns
tEr, t Ef	Fig. 2	-	_	25	ns
t AS	Fig. 2	140	_	_	ns
t AH	Fig. 2	10	_	_	ns
t DDR	Fig. 2	-	_	320	ns
t DHR	Fig. 2	20	_	-	ns
	tcyc E PWEH tEr. t Ef t AS t AH t DDR	tcyc E Fig. 2 PWEH Fig. 2 tEr. t Ef Fig. 2 t AS Fig. 2 t AH Fig. 2 t DDR Fig. 2	tcyc E Fig. 2 1.0 PWEH Fig. 2 450 tEr. t Ff Fig. 2 - t AS Fig. 2 140 t AH Fig. 2 10 t DDR Fig. 2 -	tcyc E Fig. 2 1.0 — PWEH Fig. 2 450 — tEr, t Ef Fig. 2 — — t AS Fig. 2 140 — t AH Fig. 2 10 — t DDR Fig. 2 — —	tcyc E Fig. 2 1.0 — — PWEH Fig. 2 450 — — tEr. t Ef Fig. 2 — — 25 t AS Fig. 2 140 — — t AH Fig. 2 10 — — t DDR Fig. 2 — 320

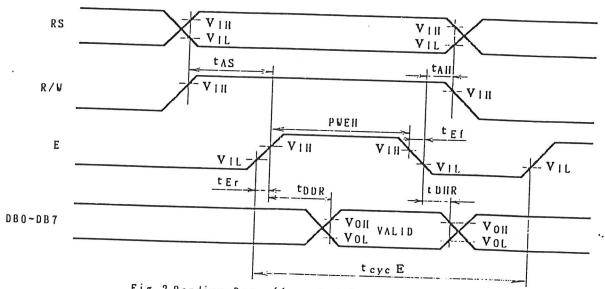
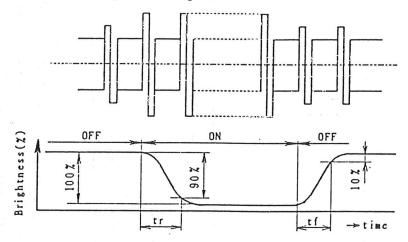


Fig. 2 Reading Data (from Module to MPU)

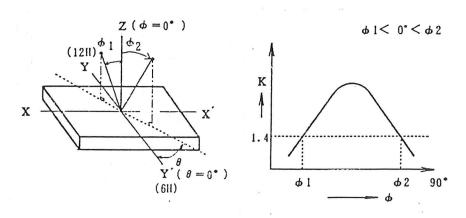
5. OPTICAL CHARACTERISTICS

	Reflectiv	e type Viewin	$V_{DD}-V_{O}=8.2V$. Ta=25°				
Item	Sym.	Condition	Min.	Typ.	Max.	Unit	Ref.
Rise time	tr	$\phi = 20^{\circ} \theta = 0^{\circ}$	_	150	250	ms	Note 1)
Fall time	tf	$\phi = 20^{\circ} \theta = 0^{\circ}$	_	150	250	ms	Note 1)
Contrast	K	$\phi = 20^{\circ} \theta = 0^{\circ}$	3	_	_	_	Note 3)
View area	ø 1∼ ø 2	$\theta = 0^{\circ}$ K=1.4	40	_	¹ —	DEG.	Note 2)
view area	θ	$\phi = 20^{\circ} \text{ K} > 1.4$	±30	T	-	DEG.	Note 2)

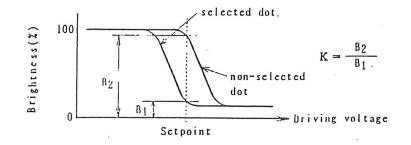
Note 1) Definition of optical response



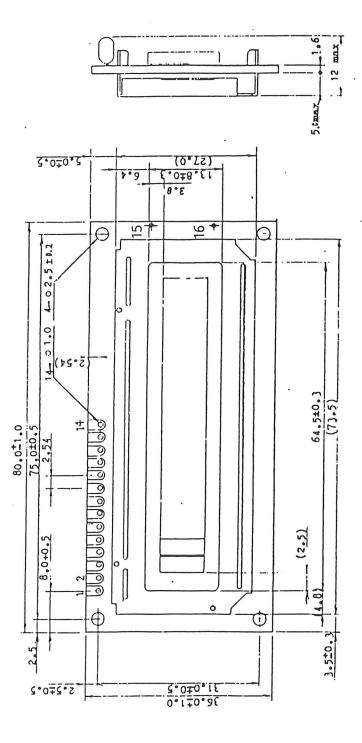
Note 2) Definition of angle θ and ϕ



Note 3) Definition of contrast 'K'

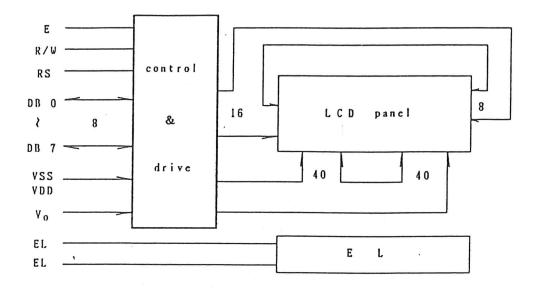


LCM-567-



6. DIMENSIQNS

7. BLOCK DIADRAM

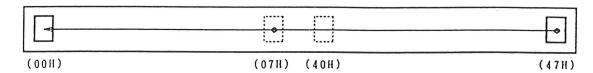


8. PIN CONNECTION

Pin No.	Signal	Pin No.	Signal
1	V _{SS}	9	DB 2
2	V _{DD}	10	DB 3
3	V _o	11	DB 4
4	RS	12	DB 5
5	R/W	13	DB 6
6	E	14	DB 7
7	DB 0	· 15	EL
8	DB 1	16	EL

9. RETURN HOME

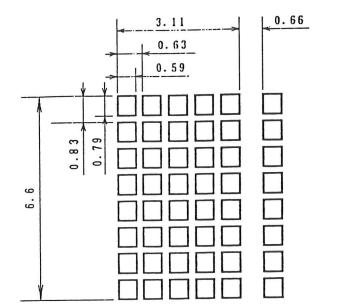
After execution



Before execution

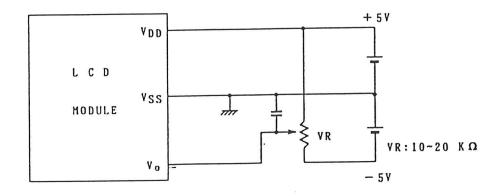
Cursor returns to home position (00H) by executiog "RETURN HOME" command.

10. DISPLAY PATTERN



UNIT : mm

11. POWER SUPPLY



12. PIN FUNCTION

Pin Name	1/0	Function
VSS		GND : OV
V _{DD}		+ 5V
VO		Power supply for LC driving
RS	I	Signal to select registers "0": Instruction register (for write) : Busy flag , address counter (for read) "1": Data register (for read and write)
EL		Drive voltage for EL (electro luminescent lamp) AC 100V (RMS) 400Hz type
R/W	I	Signal to select read (R) or write (W) "0": write MPU → LCD Module "1": read MPU ← LCD Module
E .	I	Signal to enable read and write of each LSI data (Active H)
DB 0 S DB 3	I/0	Data bus of lower order 4 lines having bidirectional port. Used for data transfer between the MPU and the module. These four are not used during 4 bits operating.
DB 4 \$ DB 7	1/0	Data bus of higher order 4 lines having bidirectional port. Used for data transfer between the MPU and the module. DB7 can be used as a BUSY FLAG.

NOTE: In the module, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

- (1) When interface data is 4 bits long, data is transferred using only 4 buses of DB4 ~ DB7, DB0 ~ DB3 are not used. Data transfer between the module and the MPU complete when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of DB4 ~ DB7 when interface data is 8 bit long) is transferred first and lower order 4 bits (contents of DB0 ~ DB3 when interface data is 8 bits long).
- (2) When interface data is 8 bits long, data is transferred using 8 data buses of DBO ~ DB7.

13. TABLE INSTRUCTIONS

Instruction	L					Code	,	,	,	,	Description	Execution time	
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DBO		(When lose is 250KHz)	
Clear display	0	0	0	0	0	0	0	0	0	1	Clears all display and returns the cursor to the home position (Address 0)	- 82µs ~ 1.64ms	
Return home	0	0	0	0	0	. 0	0	0	1	*	Return the cursor to the home position (Address 0). Also returns the display being shifted to the original position. DD RAM contents remain unchanged.	- 40µs ~ 1.6ms	
Entry mode set	0	0	0	0	0	0	0 .	1	1/0	S	Sets the cursor move direction and specifies or not to shift the display. There operation are performed during data write and read.	4048	
Display ON/OFF ontrol	0	0 .	0	0	0	0	1	D	С	В	Sets ON/OFF of all display (D) cursor ON/OFF (C), and blink of cursor position character (B).	40µs	
Cursor or display shift	0	0	0	0	0	1	S/C	R/L	*	*	Moves the cursor and shifts the display without changing DD RAM contents.	40µs	
Function sct	0	0	0	0 .	1	DL	N	F	*	*	Sets interface data length (DL) number of display lines (L) and character font (F).	40µs	
Set CG RAM address	0	0	0	1			۸С	j			Sets the CG RAM address CG RAM data is sent and received after this setting.	40µs	
Set DD RAM address	0	0	1				ΛDD	4			Sets the DD RAM address DD RAM data is sent and received after this setting.	40µs	
Read busy flag	0	1	BF				۸C				Reads Busy flag (BF) indicating internal operation is being performed and reads address counter contents.	ļµs	
Urite data to CG or DD RAM	1	0			Wri	tc Dat	a				Writes data into DD RAM or CG RAM.	40µs	
cad data from G or DD RAM	1	1			Rea	d Data					Reads data from DD RAM or CG RAM.	40µs	
	I/D S S/C S/C S/C R/L R/L DL S BF BF C C S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S S C S C S S C S C S C S S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S C S	= 0 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 :	Display Cursor Shift t Shift t Shift t Shift t Shift d Shift t Shift d Shift t Shift t Shift t Shift t Shift t	Int Inies display shift. In shift In move In the right. In the left. I							DD RAM: Display data RAM CG RAM: Character generator RAM ACC: CG RAM address ADD: DD RAM address Corresponds to cursor address. AC: Address counter used for both of DD and CG RAM address.	Execution time changes when frequency changes. (Example) When fose is 270KHz. 4045X \frac{250}{270} = 3745	

^{*} Don't care

14. RESET FUNCTION

The module automatically performs initialization (reset) when power is turned on (using internal reset circuit). The following instructions are executed in initialization.

(1) Clear display

The BUSY FLAG is kept in the busy state (BF=1) until initialization ends. The time is 15ms.

(2) Function set ·····DL=1 : 8 bits long interface data

N=0 : 1-line display

F=0 : 5×7 dot character font

(3) Display ON/OFF control·····D=0 : Display OFF

C=0 : Cursor OFF

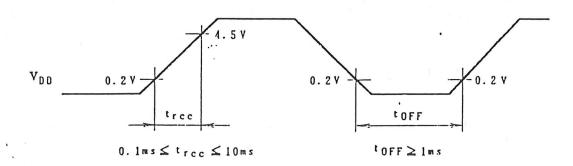
B=0 : Blink OFF

(4) Entry mode set ······I/D=1: +1 (increment)

S=0 : No shift

(5) DD RAM selected

Because initialization may not be performed completely depending on the rise time of the power supply when it is turned on, pay attention to the following time relationship.



tOFF stipulates the time of power OFF for power supply instantaneous dip or when power supply repeats ON and OFF.

NOTE: When the above power supply condition is not satisfied, the internal reset circuit does not operate normally.

ACTEX LYII													
Higher Lower thit	0000	0010	0011	0100	0101	0110	0111	róro	1011	1100	1101	1110	1111
****0000	CG RAM (1)		9 00	# # # # # # # # # # # # # # # # # # #	# # # # # # # # # # # # # # # # # # #	**	1004 1000 1000 1		00000	2 d d d d d d d d d d d d d d d d d d d	904 904 904		9 00 q
××××000i	(2)	4 4	. 80 9 8 8 9			300 900 900 900 900		11 a d p 4 o a s	9 9 9	yeaa		8 4 0004 0004	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
××××0010	(3)	0 0	4 d d		0 4 8 B B B B B B B B B B B		1 2 4 0 0 0	9 8		d 0 0		900	, od , od , od
××××0011	(4)		9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	9 0 0 0 0 0 0 0	# # # # # # # # # # # # # # # # # # #	1 9 d	9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	9 1 1 9 0 0	9 9	g a a a a a a a a a a a a a a a a a a a	4	, , , , , , , , , , , , , , , , , , ,	:
××××0100	(5)	100 d	n q	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	0 10 1 10 1 0 0	1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	•••	P8084	1 1 2 2 4 4 9		9 B 8 B 9 B 9 B 9 B	1 0 0 0 0 0 0
××××0101	(6)	P PA U PA B PA U PA	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	8 4 8 8 9 8 9 4 8 4 8 8	9 4 6 9 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	200 d q			9 0 9 0 0 9 0 9 0 9 0	p = 0 0 0 0	80 d 8 8 8 8	2 9 4 5 9 5 9 5	# U U U U U U U U U U U U U U U U U U U
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××××0111	(8)		3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	9 8 8 8 8 8 8 8 8 8 8 9 9	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0	U 0	T.,,,,	1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	# # # # # # # # # # # # # # # # # # #	unun y	9 a a a	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
××××1000.	(1)	,	9 9						9 4	9 9 9 9	8 8 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	,,,,,	4 . 8
××××1001	(2)	9 9	v	0 0 0 0 0 1 1 1 1 1 1	4 4 4	9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	p	, , , , , , , , , , , , , , , , , , ,	9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	2 4 5 5 6 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6		8 8
××××1010	(3)	# B B B B B B B B B B B B B B B B B B B		5 0 5 0 6 0 7 0 7 0	9 B U U Saso	6 B B B B B B B B B B B B B B B B B B B	2000 9 10 10 10 10	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	9946				2000 E
××××1011	(4)		3 U B U A A A A			4 4 2 4 4 4	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	54 9	9 0 a d 9 0 a d 0 0 0	9 4 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	# # # # # # # # # # # # # # # # # # #		
×××1100	(5)	p.d		4 6 0 1 1 4	,,,,,	4	4 8 9 0 1	, ,		9 9 9 9	9 9		90009
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 ××××1110	(7)	0.0		4			4 1000			1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		. 4	
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PRECAUTION FOR USING

1. Handling

- (1) Do not touch, press, or rub the display panel with a hard tool or object such as tweezers as the polarizers in the panel are easily scratched.
- (2) Do not use organic solvents to clean the display panel off as these solvents may be adverse to polarizer. To clean the surface off, dried cloth, dampened absorbent cotton with petroleum benzine or adhesive tape are preferable.
- (3) Do not touch electrode terminals of p. c. board or LSI leads.
- (4) Avoid using or storing the module under the conditions of high temperature and high humidity.

When stored, this module should be packaged in a conductive polyethylene bag and placed under the certain condition where the temperature is relatively low (5 - 30°C). The direct sunlight or fluoresent lamp must be shut off.

2. Operating

- (1) Do not connect or disconnect the Module to or from main system while power is being supplied.
- (2) Use the module within specified temperature; otherwise it causes the retardation of blinking speed of the display below specified temperature and causes the display to get dark above specified temperature.
- (3) Adjust the LC driving voltage (Vo) so that the display shows optimum contrast.

3. Men working

- (1) Use a grounded soldering iron when connecter terminals are soldered.
- (2) Do not disassemble. In case that, after disassembling, the module doesn't work due to failure of reassembly, it is not our resposibility.
- (3) In case that the molule is shipped without EL and customers use the module inserting EL afterward, it is not our responsibility for any troubles occurred in relation to such insertion.
- (4) Care should be taken not to charge static electricity, as the circuit of this module contains CMOS LSIs. A workman's body should be grounded with an earth-band. The material which prevents static electricity should be selected for a working cloth.

APPEARANCE LIMITATION (L C D)

Regulation of the following items that appear in the effective display area (1) Black spots, foreign articles, pinhole, white spots

Dimension D (mm)	Numbers
D ≤ 0.15	No Count
0.15 < D ≤ 0.20	N ≤ 2
0.20 < D	N = 0

(2) White line, black line, scratch

Width W (mm)	Length L (mm)	Numbers
W ≤ 0.03	L ≤ 0.5	No Count
$0.03 < W \le 0.05$	$0.5 < L \le 2.0$	N ≤ 3
0.05 < W	2.0 < L	N = 0

(3) Bubbles of polarizer

Diameter D	(mm)	Numbers
D ≤ 0.5		No Count
$0.5 < D \le 1.0$		N ≤ 3
· 1.0 < D		M = 0

(4) Line, scratch of polarizer

Width W (mm)	Length L (mm)	Numbers
W ≤ 0.3		No Count
0.3 < · W ≤ 1.0	$\begin{array}{cccc} & L & \leq & 5.0 \\ 5.0 & < & L & \leq & 10.0 \\ 10.0 & < & L & \end{array}$	No Count $N \le 2$ $N = 0$
1.0 < W		N = 0

- (5) Bruise of both sides of polarizer No more than 2 pcs.($D \le 0.3$)
- (6) Uneven color
 Close to uniformity. (See specimen)